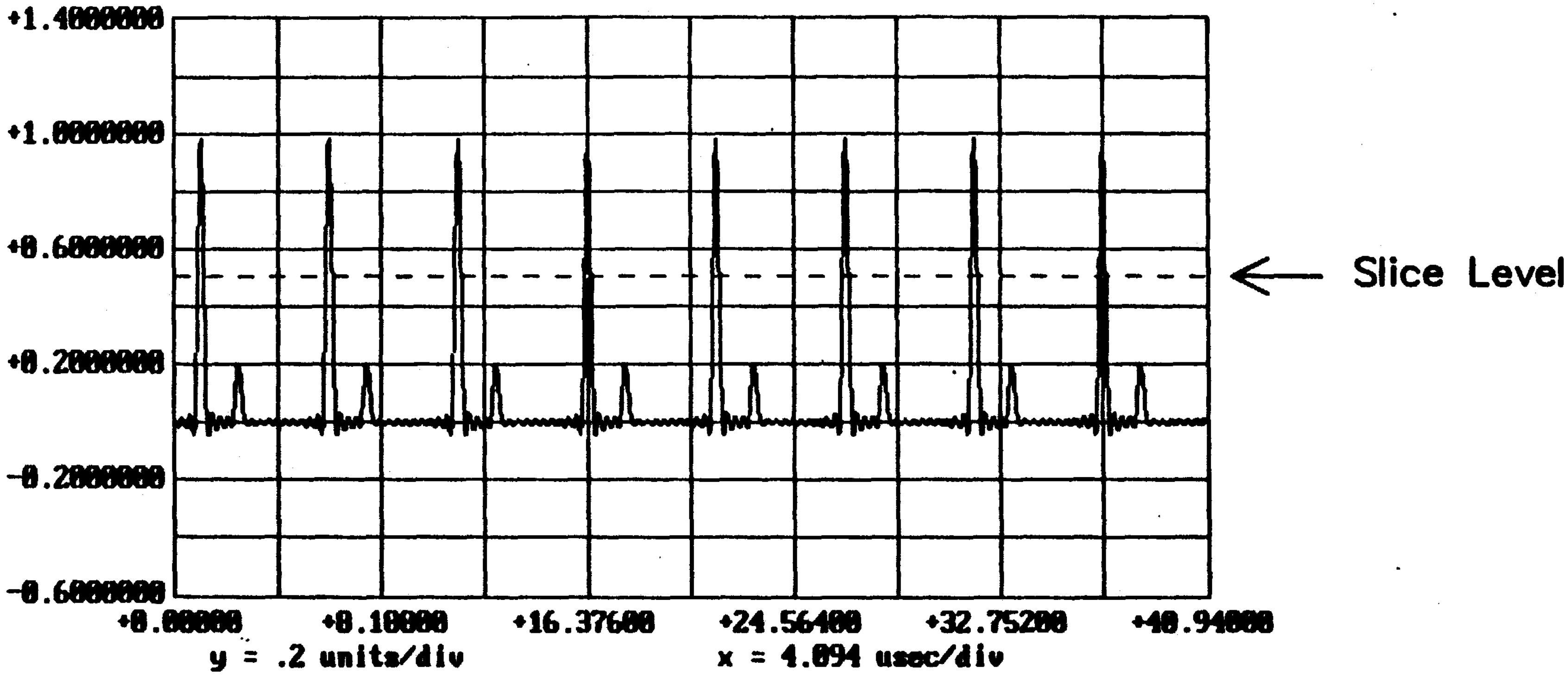

Received Chain of Pulses with Ghosts

Figure 4—11

Zenith
9/1/88

5. BENEFITS OF THE SPECTRUM COMPATIBLE PROPOSAL TO TERRESTRIAL BROADCASTING

5.1 IMPROVED PICTURE RESOLUTION AND AUDIO PERFORMANCE

True high-definition pictures, with both horizontal and vertical resolution approximately doubled, are obtained in a wide aspect ratio format. Two channels compared to NTSC of CD-quality audio are available.

5.2 UTILIZATION OF EXISTING BROADCAST SPECTRUM

Compatibility with existing NTSC VHF and UHF broadcast channels and compatibility with existing NTSC receivers is achieved by the optimal transmission/encoding system. In the way of a review and summary, this spectrum efficiency, which enables coexistence of HDTV and NTSC broadcasts, results because the HDTV does not interfere with the NTSC signals and the HDTV signal is rugged with respect to interference from NTSC transmissions.

5.2.1 VISIBILITY OF INTERFERENCE INTO NTSC FROM HDTV IS REDUCED BY:

5.2.1.1 TRANSMISSION PROCESSING

- Removal and digital transmission of low-frequency video, d.c., and sync information: reduces transmitted power

- Temporal Filtering (Field Processing): reduces transmitted power on stationary images

- Companding (compression): reduces interference from peak video components

- Time Dispersion: spreads detail information and reduces the magnitude of peak interfering components

- NTSC-Like Transmission: horizontal and vertical transmission rates of the HDTV signal resemble NTSC which enables use of precise carrier frequency offset

5.2.1.2 MODULATION CHOICES

- No subcarriers: substantially reduces non-linear intermodulation products

- Centering of the suppressed carrier: protects adjacent channels and reduces visibility of co-channel interference

5.2.1.3 SPECTRUM ALLOCATION CONSIDERATIONS

- Precise Carrier Frequency Offset (±1 Hz): reduces cochannel interference visibility

- Frame Synchronization: enables digital data to occur during NTSC vertical blanking time

- Transmitter Colocation, if required: enables equal Desired/Undesired signal strengths if the HDTV transmitter is colocated with this dominant interfering transmitter in a given service area

5.2.2 VISIBILITY OF INTERFERENCE INTO HDTV FROM NTSC IS REDUCED BY:

5.2.2.1 RECEIVER PROCESSING

- Temporal Filtering (Field Processing): cancels NTSC co-channel interference

- Time Dispersion: spreads in time and reduces the magnitude of received interfering components

- NTSC-Like Transmission: horizontal and vertical transmission rates of the HDTV signal resemble NTSC which enables use of precise carrier frequency offset

- Companding (Expansion): reduces visibility of interference by masking

- High-Frequency De-Emphasis: attenuates undesired signals

- Use of Directional Antennas: in extreme interference locations, antennas with improved front-to-back ratios could be employed

5.2.2.2 MODULATION CHOICES

- No subcarriers: substantially reduces non-linear intermodulation products

- Centering of the suppressed carrier: allows better filtering of adjacent channels and reduced visibility of co-channel

5.2.2.3 SPECTRUM ALLOCATION CONSIDERATIONS

- Precise Carrier Frequency Offset ($\pm$1 Hz): reduces cochannel interference visibility

- Frame Synchronization: NTSC vertical blanking occurs during non-picture time

- Transmitter colocation, if required: enables equal Desired/Undesired signal strengths if the HDTV transmitter is colocated with the dominant interfering transmitter in a given service area

5.2.3 NO NEW SPECTRUM REQUIRED

The above techniques, taken as a complete encoding, transmission and receiving system, allow for the use of VHF/UHF spectrum, as is, including Taboos.

5.3 IMPROVEMENTS IN NOISE PERFORMANCE

- True Constant Luminance Principle: Signal-to-Noise Ratio in Saturated Blues and Reds is improved compared to NTSC

- Pre- and De-Emphasis: high frequency noise is reduced

- Time Dispersion: impulse noise is reduced

- Companding: noise in highly visible large areas is reduced at the expense of increased noise in less visible moving edges

- Temporal Filtering: reduces the effective noise bandwidth

- When Zenith Spectrum Compatible HDTV Service is provided over vacant NTSC allocations, or whenever existing NTSC allocations do not require the maximum available margin of protection from the (new) HDTV Service, part of the reduction in average and peak power over NTSC transmission can be used to provide higher signal-to-noise ratio

5.4 HDTV TRANSMITTER CONSIDERATIONS

5.4.1 TRANSMITTER AVERAGE POWER REDUCTION

At the transmitter there are economic benefits due to the average power reduction. The typical NTSC UHF high power installation delivers 5 megawatts ERP, using an antenna gain of 16 dB (40/1 power) and transmitter power of 125 KW. This requires 240 KW of a.c. power. The annual power bill for such a transmitter operating for 18 hours/day, 7 days/week, 52 weeks/year, at $0.12/Kwatt-hour is $189,000.00.

The average power required for the HDTV proposal consists of three components, namely, VBI data, pilot carrier (for carrier regeneration in the receiver), and analog video high frequencies. Each of these components are approximately 32 dB less (1600/1 power reduction) than an equivalent NTSC video signal sync peak. This results in a 533/1 (27 dB) power reduction. The HDTV transmitter average power requirements using the same antenna gain is 225 watts, or, with a 10 dB antenna gain the power requirement is 1 KW. The annual power bill in this case is only $786.00.

5.4.2 TRANSMITTER PEAK CONSIDERATIONS

While the average power is considerably reduced (effectively eliminating the need for water cooling or air cooling or pulsed Klystrons to develop peak power), the peak voltage characteristics of the HDTV signal (consisting of two principal components - VBI data, and analog high frequencies) are the same as a normal NTSC signal. Thus, the voltage breakdown requirements of the major transmitter components - the output devices (tubes, and circuits), coaxial lines/waveguides, and antenna are not changed.

6. EXTENSIONS OF THE ZENITH SPECTRUM COMPATIBLE SYSTEM TO OTHER TELEVISION MEDIA

6.1 CABLE TELEVISION

Since the cable plant, for the most part, makes use of the AM signal used by terrestrial broadcasts, all of the advantages of the HDTV proposal are ideally applicable. The power reduction and the elimination of sound and chroma carriers improves the signal-to-noise ratio performance without cable plant rebuild, and reduces intermodulation distortions.

6.2 SATELLITE AND TAPE RECORDING (FM SYSTEMS)

Those systems using frequency modulation (FM), such as satellite and magnetic tape, are accommodated by using a time-multiplexed (MAC Format) technique instead of I and Q carriers. The components which modulate the I and Q carriers in the case of terrestrial broadcasts and cable are, instead, time compressed 2:1 and then time-multiplexed.

The average power reduction, taken as an advantage in the terrestrial broadcasting and cable applications, is manifested in FM systems as significant reduction in average and peak deviation for improved signal-to-noise ratio performance and improved threshold performance.

6.3 TRANSCODABILITY TO NTSC

The HDTV Signal is easily transcodable to NTSC since the scan rates are deliberately related. Simple interpolation filters are used to convert from the HDTV 787.5 line progressive format to the NTSC format. Conversion may be to either NTSC composite or Y/C.

6.4 ENCRYPTION CONSIDERATIONS

Digitized low-frequency video and digital audio may be directly hard encrypted. Additional video scrambling is possible by using a random interchange of components under control of subscriber address/key-passing arrangements. The audio, being digitized, can be hard encrypted, with its own stream cipher, if desired. The data used for controlling the encryption system is transmitted in the vertical interval.

6.5 CONVERSION BETWEEN MEDIA

Conversion between AM (terrestrial broadcasting, Cable) and FM (Satellite, Magnetic Tape) formats is straight forward. The encoded signal does not need to be decoded, and, in the case of encryption, the signal can be recorded in encoded format.

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APPENDIX B

ZENITH

ZENITH ELECTRONICS CORPORATION ☐ 1000 MILWAUKEE AVENUE ☐ GLENVIEW, ILLINOIS 60025-2493

ROBERT B. HANSEN
PRESIDENT,
CONSUMER PRODUCTS GROUP
(312) 391-7380
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August 3, 1988

Mr. Hugh Thuerk
Director
Board of Standards Review
American National Standards Institute
1430 Broadway
New York, New York 10018

Re: Proposed National Standard for Television - Signal Parameters - 1125/60 High-Definition Production System

Dear Mr. Thuerk:

Zenith has been actively involved in the consideration of the proposed standard via participation in the Advanced Television System Committee (ATSC) working group. Although the ATSC approved (by the narrowest of margins) the 1125/60 parameters as a production standard, Zenith, as well as many major American companies, voted against the approval. In addition to Zenith, the other two major United States television receiver manufacturers, North American Philips and Thomson (RCA), voted against the approval as did two of the three major United States broadcasting networks (ABC and NBC) and the National Association of Broadcasters and the Association of Maximum Service Telecasters.

The proposed 1125/60 production standard is simply not compatible with existing U.S. production and transmission standards. The proposed 60Hz field rate is uncompatible, and not readily transcodable, with the existing U.S. standard rate of 59.94 Hz. In addition there is no common integral multiple between the existing 525 NTSC line rate and 1125. While complicated and expensive conversions might be considered, deleterious artifacts would necessarily result. It should also be noted that the 1125/60 proposal is equally incongruent with current and future European 625/50 standards.

While the 1125/60 system is proposed as a production format, the development of a transmission standard for the U.S. (and North America) cannot be divorced. None of the major high definition television transmission system proposals, including that of Zenith, are compatible with the 1125/60.

The proposed 1125/60 production standard requires the use of a 16 x 9 aspect ratio. While it may be desirable to have wider aspect television in conjunction with higher resolution (high definition) television, it is entirely too early to assume that high resolution and increased aspect ratio are inseparable. Further studies are required. The 1125/60 proposal is not compatible with the 4 x 3 aspect ratio of the existing 160 million NTSC receivers in the U.S.

Based on our numerous contacts within the U.S.-based television broadcasting, cable, direct broadcast satellite, and television manufacturing industries, we believe there is considerable opposition to the establishment of the 1125/60 as an ANSI/American standard.

Sincerely,

RH/WCL/e

cc: S. Becker (SMPTE)
W. Luplow

PS/WG-3 —
0063

INTERFERENCE PENETRATION BY TRANSMITTERS OPERATING AT MINIMUM TABOO SPACINGS

to be appended to PS/WP3- (T.B.D.) "Further Discussion of Taboos and TV Receiver Performance"

In two previously submitted papers, television receiver interference performance data from the FCC Report FCC/OET TM-1 by Hector Davis were compared to Undesired to Desired signal ratios at the receiver that could occur with transmitters operating at Taboo channels and located at the minimum separation from the Desired Channel. F (50, 50) propagation curves were used for the Desired Signal and F (50, 10) curves were used for the Undesired Signal in the most recent paper. Grade B Planning Factors were applied with 13 dB receiving antenna gain in the direction of the transmitters and 0 dB in the reverse direction. The receiving antenna was assumed to be in-line with the two transmitters.

The graphs submitted herewith are an extension of the previous graphs in that the receiver is not limited to be in-line with the transmitters, and the plots are two dimensional with respect to the location of the transmitters.

Each figure shows two or four pairs of contours. Each pair corresponds to a Taboo condition.

The Desired Transmitter is located in the center of the graph and the Undesired transmitter is located at the minimum distance for the particular Taboo; + marks indicate the locations of the transmitters. The transmitters are assumed to operate at 5 Megawatt at H.A.A.T. of 1200 feet and radiate omni-directionally.

A computer program was written to calculate (from the F (50, 50) and F (50, 10) propagation curves and the Grade B Planning Factors) the desired and undesired signals at the TV receiver versus location in the Grade B area for 13 dB antenna gain but no antenna directivity. From these data and the receiver performance data of the FCC/Davis report, the program calculates the contours inside of which the threshold of perceptible interference is exceeded.

The outer contour corresponds to the mean receiver performance and the inner contour corresponds to the upper decile receiver performance.

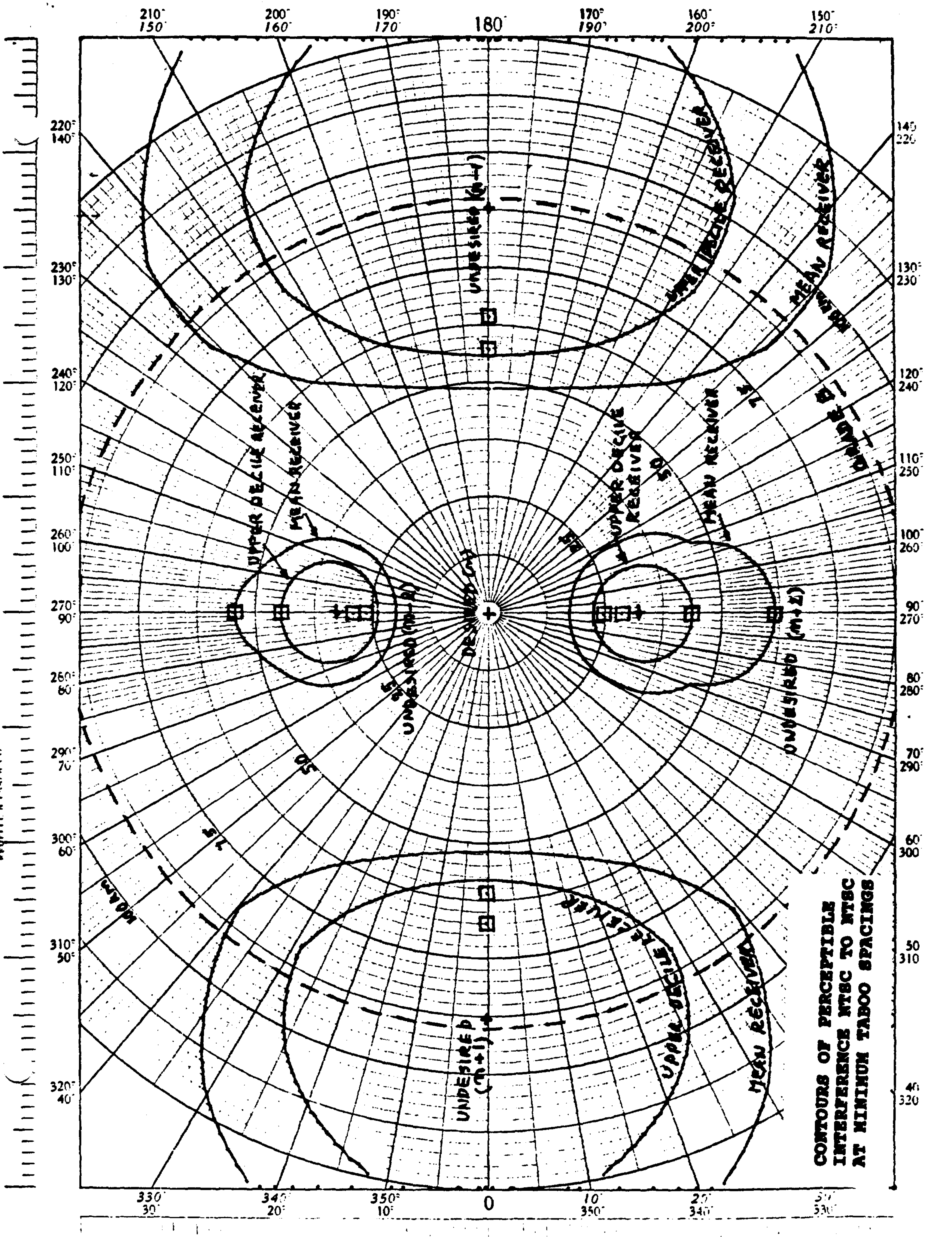
The square marks correspond to two points through which the contours would go if 10 dB of front-to-back were included. The computer program does presently not allow for inclusion of antenna pattern.

The discontinuities in the contours are caused by the fact that the receiver data were not continuous.

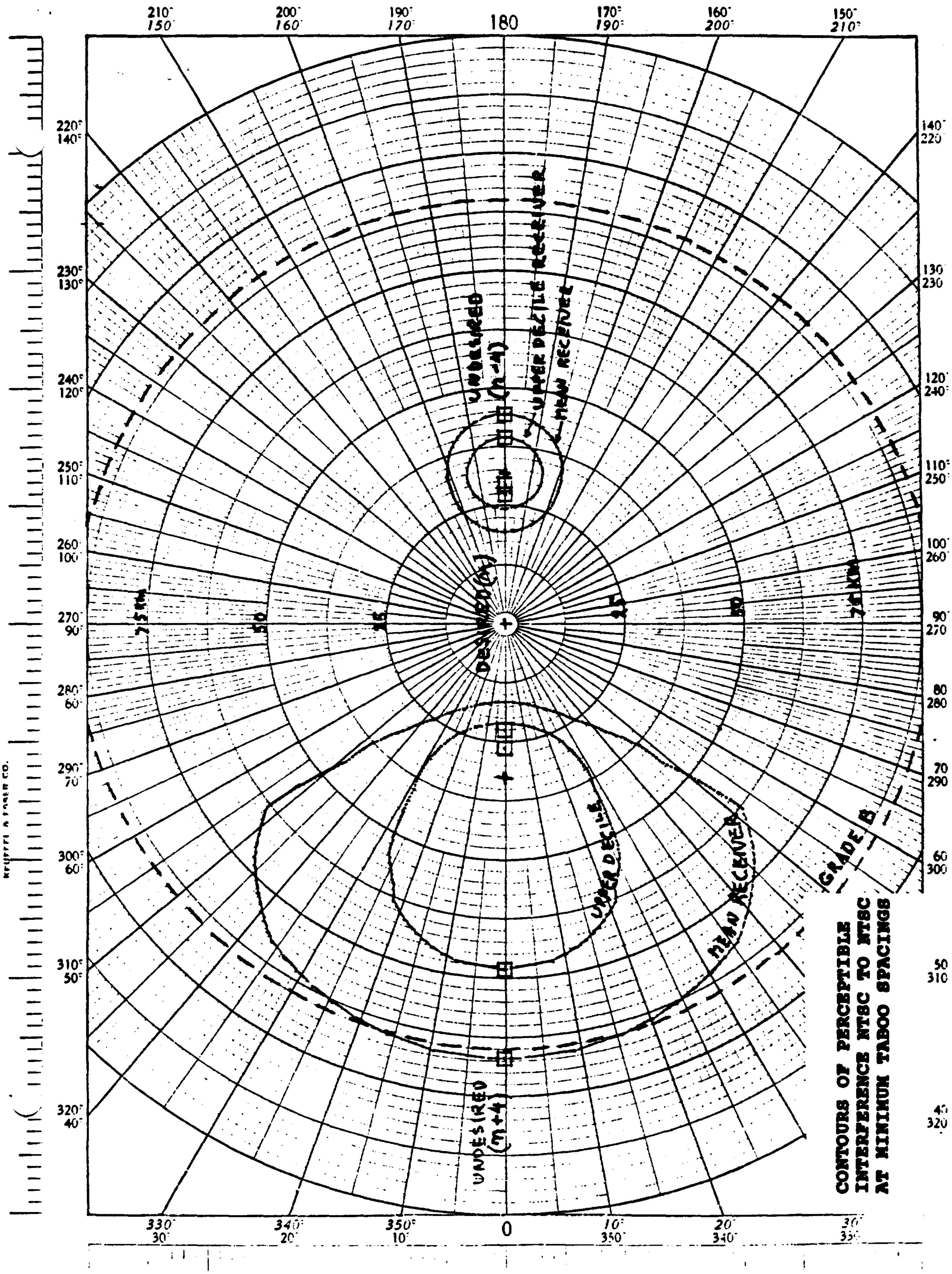
It appears that this form of presentation of measured interference data for the various proponent systems would be very meaningful and easy to interpret for spectrum managers and broadcasters.

The data on the receivers can still be taken in the conventional way of U/D versus Desired signal level.

J. Rypkema
9/1/88



CONTOURS OF PERCEPTIBLE INTERFERENCE NTSC TO NTSC AT MINIMUM TABOO SPACINGS



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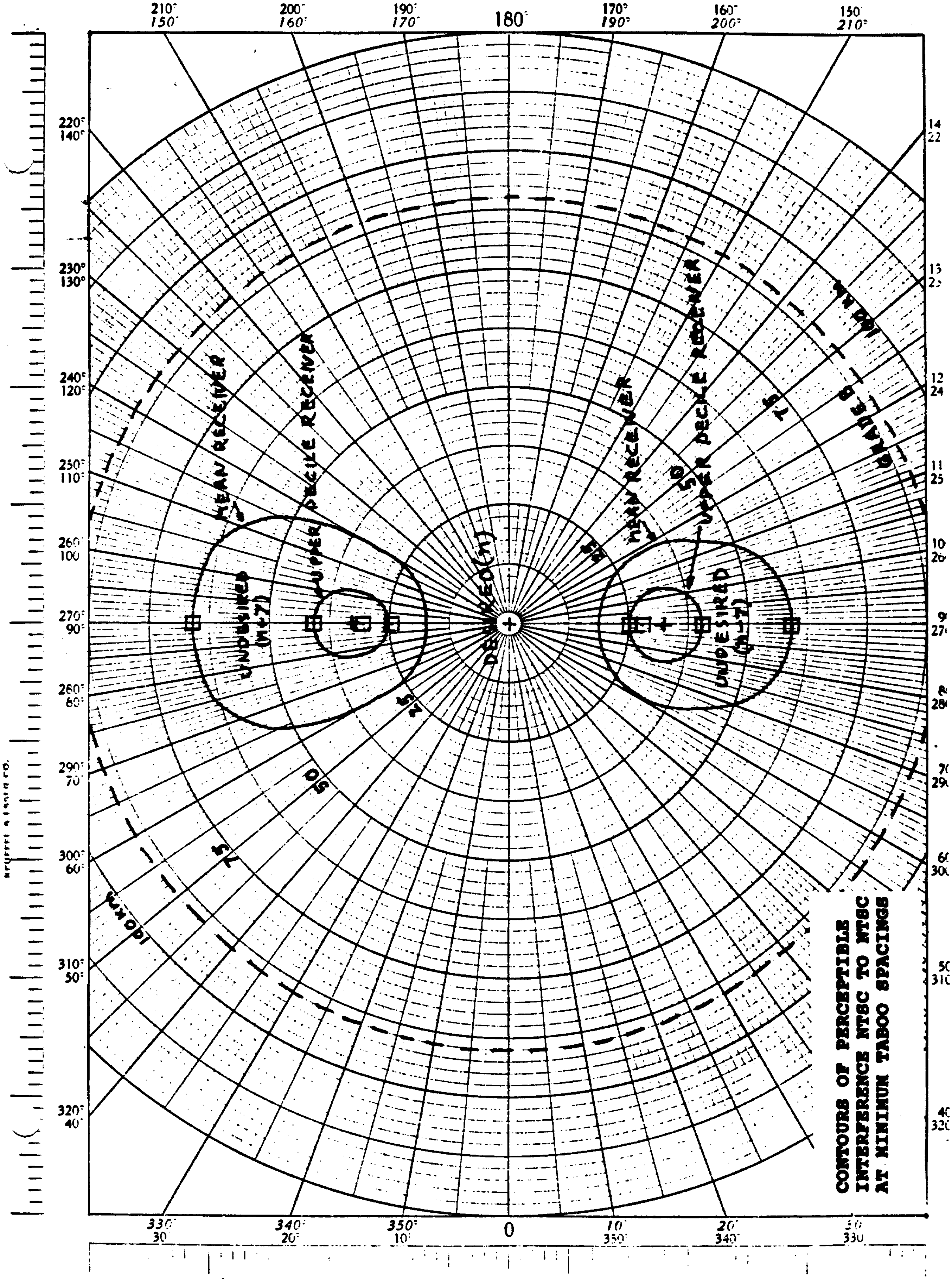

180°
0
DESIRED (N)
UNDESIRED (N+7)
UNDESIRED (N-7)
MEAN RECEIVER
UPPER DECILE RECEIVER
GRADE B 100 km
25
50
75
100 km
K&E POLAR CO-ORDINATE
46 4412
KEUFFEL & ESSER CO.
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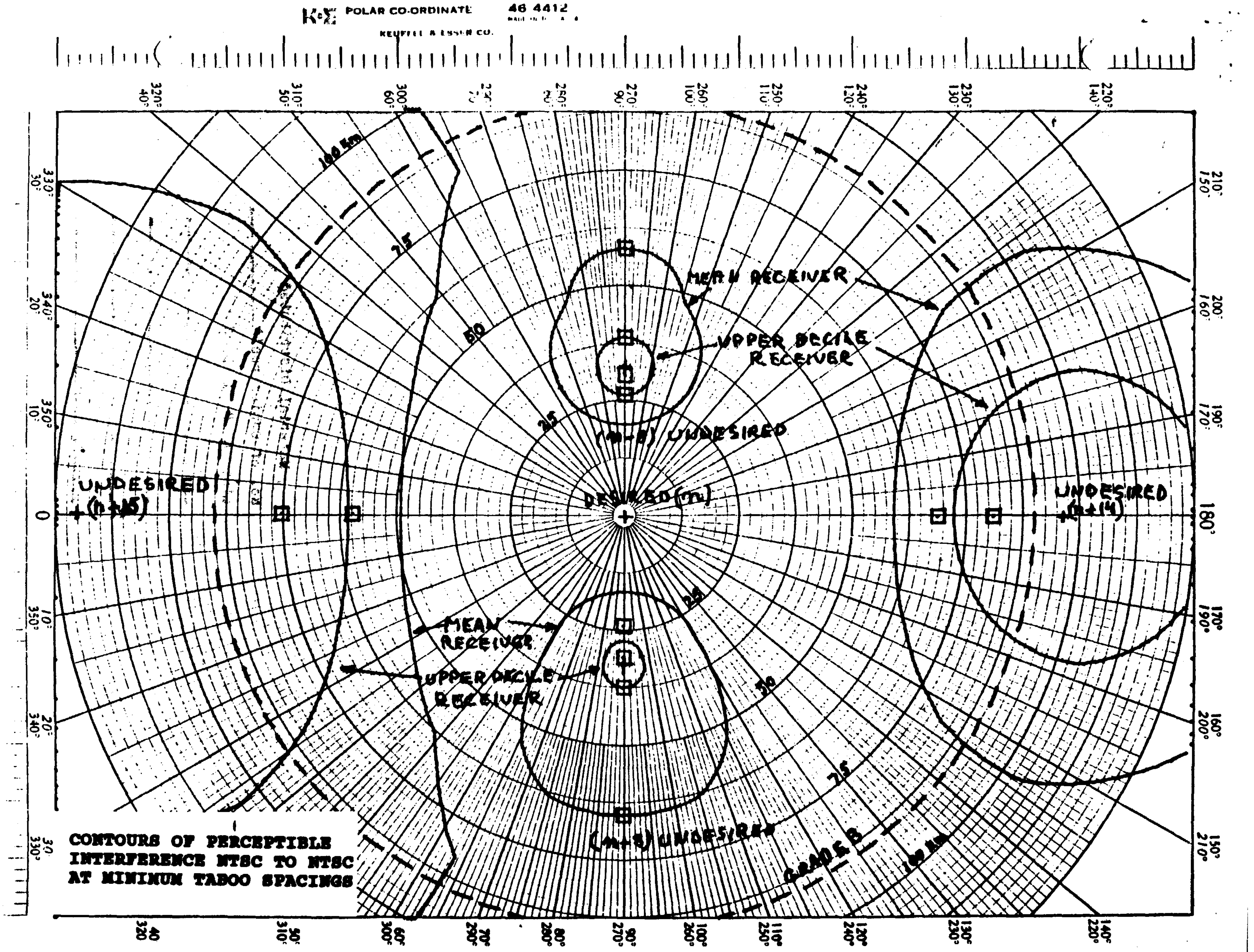

CONTOURS OF PERCEPTIBLE INTERFERENCE NTSC TO NTSC AT MINIMUM TABOO SPACINGS